1/PRTS



# DEVICE FOR MEASURING FILL LEVELS

The present invention relates to a device for measuring fill levels according to the definition of the species in Claim 1. The device is particularly suitable for use as a fill level sensor for liquids.

Different fill level sensors which utilize different physical effects are known from the related art. A capacitive sensor having a changeable dielectric is a possible design, in which, during a change in the fill level, the dielectric proportion of the medium to be measured changes within the capacitor, thereby causing a capacitance change. The fill level may be determined based on the capacitance change. Plate capacitors or flat capacitors (inter-digital structures) designed on the basis of printed boards or punchings are possible in addition to a design as a cylinder capacitor having the appropriate coaxial structures.

The object of the present invention is to provide a device for measuring fill levels which may be manufactured cost-effectively and which enables measuring as accurately as possible.

According to the present invention the object is achieved by a device having the features of Claim 1. Advantageous embodiments and refinements are described in the subclaims.

Due to the design of the sensor using two base components, from each of which project finger-shaped electrodes, situated offset from one another, it is possible to implement a total capacitance of the device by multiplying the single capacitances by the number of electrode pairs, thereby approximately achieving a proportional ratio of the pairs of

electrodes, submerged in the medium, to the total capacitance. Using a fixing element, the base components are positioned with respect to one another in such a way that a continuous allocation takes place among the electrodes and that a minimum interfering proportion of other materials is situated between the electrodes in order to achieve measuring as accurately as possible. Furthermore, rapid flow-off or discharge of the medium during fluctuating fill levels is achieved due to the open structure in the overlapping area of the electrodes, so that a swift response to changing fill levels may take place.

A refinement provides that the sensor has a meander-shaped inter-digital structure, whereby a simple computation of the total capacitance during changing fill levels may be possible. Inter-digital structure means that there are spaces between the finger-shaped electrodes into which corresponding finger-shaped electrodes of another base component may be inserted or introduced. There is still a gap between the electrodes of the two base components which is filled by the medium to be measured. A meander-shaped path, facilitating a flow-off of the medium to be measured during fill level changes or fluctuations, is formed due to the meandering path of the gaps between the electrodes.

To achieve a design that is as compact as possible, it is provided that the electrodes of the base components are situated essentially in a plane, so that the sensor has a planar structure.

To improve the flow-off characteristics of the medium to be measured it is provided that the electrodes are tapered starting from the base component, thereby additionally improving the electrodes's mechanical stability.

Manufacturing the fixing element by using plastic injection molding or plastic extrusion coating is a very cost-effective way of aligning the electrodes and the base components to one

another; it is a tried and tested method with which great quantities of sensors having sufficient accuracy may be manufactured. Great position accuracy of the base components, and thus of the electrodes, is achieved by designing the fixing element as a frame, in particular as a closed frame; the frame may also be manufactured by using plastic extrusion coating. Since the extrusion coating material is not situated in the overlapping area of the electrodes, i.e., between the electrodes, the extrusion coating material does not act as a dielectric and the total capacitance, and thus the measuring accuracy, is not affected.

In order to manufacture the sensor as cost-effectively as possible it is provided that the base component and the electrodes are manufactured from a pressed screen, preferably in one piece, the pressed screen preferably being made of a metal which has robust characteristics in the medium surrounding it. As an alternative to such a material selection it is provided to coat the electrodes and possibly the base component with a protective coating to protect the electrodes against corrosive media.

The present invention is explained in greater detail below on the basis of an exemplary embodiment.
The sole figure shows:

- a schematic representation of a measuring device.

The figure shows a schematic representation of a sensor 1, sensor 1 being made up of two base components 2, 3 from each of which electrodes 20, 30 project in one direction. Electrodes 20, 30 are situated in a plane in the illustrated exemplary embodiment; alternative embodiments or alternative spatial positioning of electrodes 20, 30 may also be provided. Electrodes 20, 30 of both base components 2, 3 face each other and are situated offset from one another in such a way that a meander-shaped gap forms between electrodes 20, 30 into which

a medium (not shown), a liquid, for example, may penetrate. As a result of this medium's penetration, the total capacitance of sensor 1 changes due to the medium's different dielectric constant in relation to air. Depending on the fill level, the capacitance between the pairs of electrodes thus changes; an electronic unit (not shown) analyzes the signal and conveys it to a display device or regulates a system correspondingly based on the measured value.

Outside the overlapping area of electrodes 20, 30, i.e., the area in which electrodes 20, 30 do not mesh with one another, a circumferential frame 4 is injection molded onto base components 2, 3 to reliably and inexpensively fix electrodes 20, 30 in position. Finger-shaped electrodes 20, 30 are thus supported on one side on the respective base components 2, 3 and, due to frame 4, the plastic proportion between electrodes 20, 30 is negligibly small with regard to the electric capacitance. This, in particular, has the advantage of increased measuring accuracy, since conventional plastics have a high temperature sensitivity with respect to the relative dielectric constants, so that, in the presence of plastic materials between the electrodes, great non-linear changes in the partial capacitance and great non-linear temperature changes make an exact analysis of the fill level impossible.

The planar structure according to the present invention implements free-standing electrodes 20, 30 in the overlapping area, thereby making the plastic proportion negligible with respect to the capacitance and at the same time, a meander-shaped gap is achieved between electrodes 20, 30 through which the flow-off of the liquid or the medium is definitely improved. In the exemplary embodiment illustrated, electrodes 20, 30 are tapered starting from the particular base component 2, 3 ($W1 > W2$), whereby the mechanical stability of electrodes 20, 30, as well as the flow-off characteristics are further improved.

The structure of sensor 1 may be produced using a pressed screen which, for fixing purposes, is extrusion-coated with a closed or open plastic frame 4. Provided that frame 4 and thus the entire measuring capacitance is submerged into the medium to be measured, sensors for detecting the relative dielectric constants may also be implemented in this way.